LEUCISCUS KEADICUS (CYPRINIDAE), A VALID SPECIES FROM RIVER EVROTAS (GREECE)

by

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ABSTRACT. - The subspecies *Leuciscus* (*Telestes*) *souffia keadicus* from the small river Evrotas (Peloponnese, Greece) is ranked as valid species under the name *Leuciscus keadicus* Stephanidis, 1971. Dark pigmentation on the body and peritoneum, dark strip longwise of the body sides from eye to the caudal fin base, almost sub-terminal mouth with a rather acute snout, and the thick upper lip with a median fleshy elevation, are the main distinguishing characters from *Leuciscus souffia*. In addition, some morphometric diagnostic characters are given. The species is endemic of the river Evrotas.

RÉSUMÉ. - La sous-espèce *Leuciscus* (*Telestes*) *souffia keadicus* de la rivière Evrotas (Peloponnèse, Grèce) est élevée au rang d'espèce valide sous le nom de *Leuciscus keadicus* Stephanidis, 1971. Les caractères qui séparent *L. keadicus* de *L. souffia* sont les suivants: la pigmentation sombre du corps et du péritoine, la bande foncée sur les flancs, la bouche presque terminale, le museau obtus, et la lèvre supérieure mince avec une élévation médiane caractéristique. De plus, quelques caractères morphométriques sont donnés. L'espèce est endémique de la rivière Evrotas.

Key-words. - Cyprinidae, *Leuciscus keadicus*, Greece, Evrotas River, Taxonomy.

Stephanidis (1971) describes a new subspecies under the name *Leuciscus* (*Telestes*) *soufia* (sic) *keadicus* based on specimens which were collected from the small river Evrotas (Peloponnese). In his original description the author does not refer to any comparative material except those from Evrotas. Hence, any reference by him on the characters of the nominal species is derived from the available literature. According to the same author, this new subspecies *keadicus* presents all the characters of the "sub-genus *Telestes* C. Bonaparte, 1832-41: pharyngeal teeth placed in two rows (2.5-5.2), dorsal and anal fins almost equal, black pigmentation on the body and in the peritoneum, and a dark band longwise the sides from the eye to the caudal fin". Furthermore, he provides some elementary comparisons, also based upon the literature, with subspecies *soufia* (sic), *agassizi* and *muticellus*, claiming that *keadicus* is closely related to the *muticellus* from Italy. Under this classification the taxon was listed as valid by Economidis (1972-1973), Ladiges and Vogt (1979) and Economidis and Nikoletos (1981). However, the opportunity we had to examine new fresh specimens of *Leuciscus keadicus* from the river Evrotas as well as preserved ones of *Leuciscus souffia* from Romania and Slovenia (river Danube catchment), showed that the latter differs essentially from the former. Consequently, *Leuciscus keadicus* have to be ranked as a valid species. The aim of this study is to prove this rearrangement (see also Economidis, 1991).

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Table I. - Morphometric and meristic characters of *Leuciscus keadicus* (after Economidis and Nikoletos, 1981) and of *L. souffia* (original).

Characters	*L. keadicus* (river Evrotas. Greece)					*L. souffia* (river Jernica. Slovenia)				
	n	Mean ± SE	SD	F°	Range	n	Mean ± SE	SD	V	Range
Morphometric										
TL (mm)						18	137.1 ± 2.6	10.8	7.9	117.0 - 156.5
SL (mm)						18	125.7 ± 2.5	10.4	8.3	103.4 - 145.3
In % of SL										
lc (length of head)	84	24.3 ± 0.1	0.7	3.0	22.9 - 26.4	19	24.5 ± 0.2	0.8	3.2	23.6 - 25.7
H (body depth max.)	84	23.7 ± 0.1	0.9	3.6	21.8 - 26.0	19	22.9 ± 0.3	1.3	5.7	20.4 - 24.9
h (body depth min.)	84	10.7 ± 0.0	0.3	3.1	10.0 - 11.5	19	10.1 ± 0.1	0.5	5.3	9.3 - 11.3
lcp (length caudal peduncle)	82	21.9 ± 0.2	1.5	6.6	18.8 - 25.3	19	20.3 ± 0.4	1.7	8.1	17.1 - 23.0
hD (depth of D)	85	21.0 ± 0.1	0.8	3.8	19.3 - 22.8	19	19.2 ± 0.2	0.9	4.7	17.0 - 20.9
lD (length of D)	85	12.1 ± 0.1	0.8	6.8	10.6 - 15.7	19	12.1 ± 0.1	0.6	5.3	11.3 - 13.3
hA (depth of A)	84	16.4 ± 0.1	0.7	4.4	14.5 - 18.8	19	15.0 ± 0.2	1.0	6.5	13.4 - 16.4
lA (length of A)	85	11.0 ± 0.1	0.8	7.0	9.4 - 12.9	19	11.4 ± 0.2	0.7	6.0	9.4 - 12.4
lP (length of P)	84	18.2 ± 0.8	0.7	3.9	16.6 - 20.0	19	21.5 ± 0.2	1.1	5.1	19.2 - 23.0
lV (length of V)	84	15.4 ± 0.1	0.7	4.2	13.0 - 16.6	19	17.3 ± 0.1	0.6	3.4	16.5 - 18.3
pD (predorsal)	85	52.6 ± 0.1	1.2	2.3	49.2 - 55.6	19	52.1 ± 0.2	0.9	1.6	50.8 - 53.7
P-V	82	25.7 ± 0.1	1.2	4.8	23.0 - 29.4	19	26.1 ± 0.3	1.3	5.0	24.6 - 28.8
V-A	85	19.5 ± 0.1	1.1	5.7	16.6 - 23.1	19	22.9 ± 0.3	1.2	5.4	20.7 - 25.6
pV (preventral)	84	49.8 ± 0.2	1.5	3.0	47.3 - 55.8	19	49.1 ± 0.3	1.2	2.4	47.2 - 51.0
pA (preanal)	84	65.9 ± 0.2	1.7	2.5	62.6 - 70.8	19	70.5 ± 0.4	1.8	2.5	66.4 - 74.0
In % of lc										
Oh (diameter of eye)	84	27.5 ± 0.2	1.7	6.3	24.2 - 32.7	19	24.3 ± 0.4	1.8	7.5	20.8 - 28.4
prO (preorbital)	83	29.5 ± 0.2	1.5	5.2	24.5 - 34.1	19	27.6 ± 0.4	1.8	6.6	24.4 - 30.8
poO (postorbital)	84	45.8 ± 0.2	1.6	3.5	42.3 - 51.0	19	51.2 ± 0.5	2.0	3.9	46.6 - 53.9
iO (interorbital)	81	38.4 ± 0.2	2.0	5.3	33.5 - 43.7	19	34.3 ± 0.3	1.5	4.3	30.9 - 37.4
Meristic										
D (dorsal branched rays)	84	8.0 ± 0.0	0.0	0.0	8.0 - 8.0	19	7.9 ± 0.1	0.2	2.9	7.0 - 8.0
A (anal branched rays)	85	8.9 ± 0.0	0.3	3.6	8.0 - 9.0	19	8.9 ± 0.1	0.5	5.2	8.0 - 10.0
P (pectoral branched rays)	84	14.3 ± 0.1	0.7	4.6	13.0 - 15.0	19	12.9 ± 0.1	0.3	2.4	12.0 - 13.0
V (ventral branched rays)	84	8.0 ± 0.0	0.4	4.6	7.0 - 9.0	19	7.9 ± 0.1	0.2	2.9	7.0 - 8.0
l.l. (lateral line scales)	81	46.5 ± 0.2	1.7	3.7	44.0 - 51.0	18	50.3 ± 0.5	2.3	4.6	46.0 - 53.0
Sp.br. (gill rakers)	85	7.9 ± 0.1	0.8	10.1	7.0 - 9.0	7	8.6 ± 0.2	0.5	6.2	8.0 - 9.0
Vertebrae	26	39.4 ± 0.2	1.1	2.9	38.0 - 42.0	7	42.0 ± 0.3	0.8	1.9	41.0 - 43.0

MATERIAL AND METHODS

The study is based on many specimens (Table I) from the fish collection of the Institute of Biology of Bucharest and of the Zoology Department of Aristotle University of Thessaloniki. Specimens were examined and measured according to the criteria presented by Holcik (1989).

LEUCISCUS KEADICUS STEPHANIDIS, 1971

Leuciscus (*Telestes*) *soufia keadicus* Stephanidis, 1971: 198, fig. 9 (description as new sub-species from river Evrotas, Peloponnese).

Leuciscus souffia keadicus, Ladiges & Vogt, 1979: 104 (Peloponnese); Economidis and Nikoletos, 1981: 85-86 (morphometric and meristic characters, distribution: Evrotas).

Leuciscus keadicus, Economidis, 1991: 15 (listed as valid species, threats, distribution: Evrotas); Tsingenopoulos, 1994: 2-41 (karyotype, protein specificity, distribution: Evrotas); Tsingenopoulos and Karakousis, 1996: 89-92 (karyotype, protein specificity, distribution: Evrotas).

Description. - D III/8; A III/8-9(10); C 19; P I/13-15; V II/7-9; l.l. Squ. sup. 9-10/44-51/ Squ. inf. 3-4; D. ph. 2.5-5.2, Sp. br. 7-9, Vert. 38-42.

The species is characterized mainly by its almost equal dorsal and anal fins, its dark pigmentation on the body and peritoneum, its dark strip longwise of the body's sides from eye to the caudal fin base, its almost sub-terminal mouth with a rather acute snout and the thick upper lip with a median fleshy elevation. Morphometric and meristic characters based on 84 specimens from river Evrotas, are shown in table I.

The body is slightly compressed laterally and rather arched than cylindrical in shape, the head profile being almost curved and the caudal peduncle relatively long (two times long than deep). From the tip of snout up to the occiput the head has a rather convex profile. The eyes are of medium to large size and the snout short, a few rounded in front. The mouth is rather subterminal, slightly oblique and surrounded by lips of moderate thickness, the upper one bearing a characteristic elevation in its median junction (Fig. 1a). The scales are of a medium size, approximately rounded or slightly higher than longer and bearing 6 to 9 longitudinal grooves. The lateral line is complete and curving downward between the pectoral and anal fins. It usually consists of 46 to 48 scales (range 44-51). There are 9 to 10 rows of scales above and about 3 to 4 below the lateral line. The insertion of dorsal fin is lying about one eye diameter behind the anal. It has a nearly straight margin. The origin of the anal fin is behind the last ray of the dorsal fin. It has a clearly convex margin in adult specimens, while is rather straight or a slightly convex in younger ones. The caudal fin is slightly forked and both lobes are equal and almost pointed at the tip. The pharyngeal teeth are rather thin and hooked (Fig. 2a).

The color pattern (see also Stephanidis, 1971) of the alive adult fish is uniform without speckles. On the back of the body there is a rather uniform dark brown to dark blue nearly blackish. The body sides are more light with bluish shine, while the belly is silvery white. In the middle of sides there is a large blackish strip running longwise of

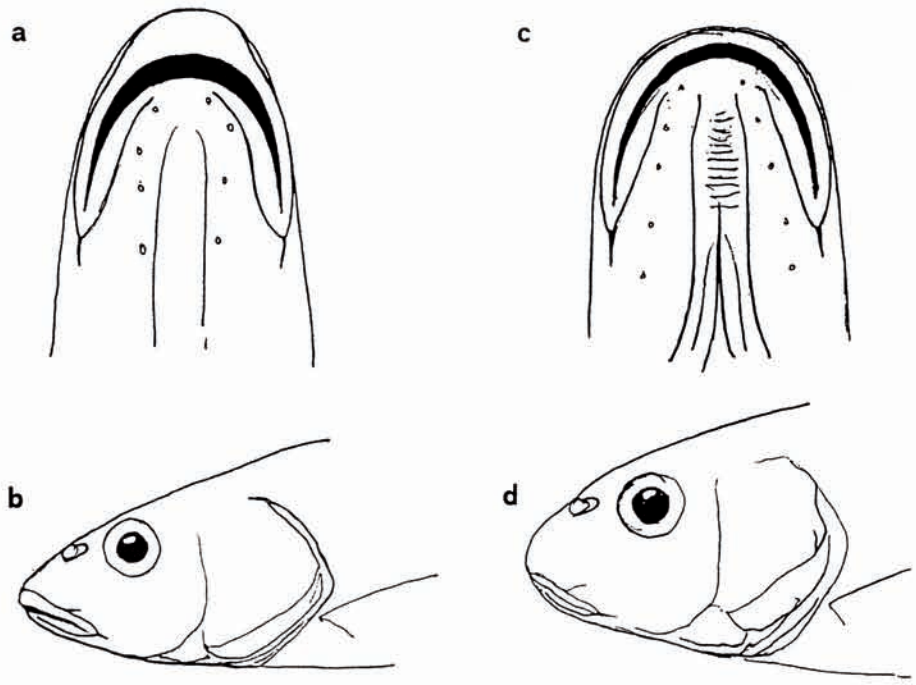

Fig. 1. - Head of *Leuciscus keadicus* (a, b) and *L. souffia muticellus* (c, d). Above (a, c) lower part and mouth, below (b, d) lateral view [drawing made by T. T. Nalbant after specimens from river Evrotas, Peloponnese, Greece (a, b) and river Nervia, Liguria, Italy (c, d)].

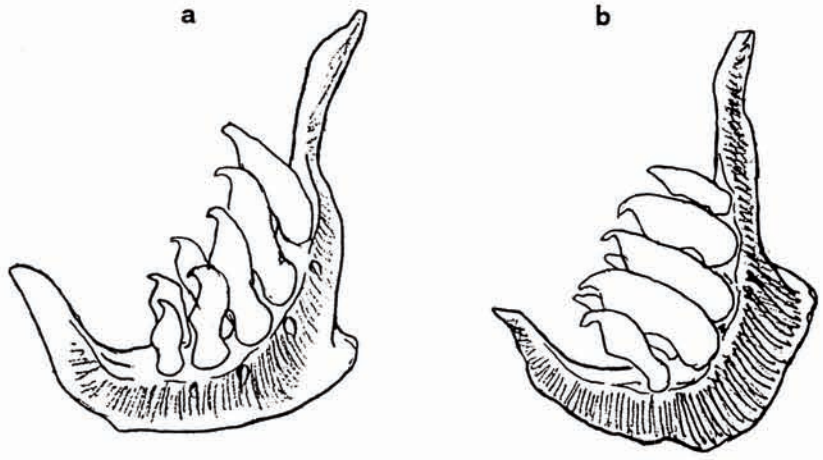

Fig. 2. - Pharyngeal teeth of *Leuciscus keadicus* (river Evrotas, Greece) and *L. souffia agassizi* (river Sapinta, Romania) (drawn by T. T. Nalbant).

the body. Laterally of the body from the back till the origin of ventrals and anal fins, mainly till lateral line, there are numerous small black spots, more concentrated near the base and the margin of the scales. Same spots there also is in peritoneum. The lateral line is yellowish, sometimes surrounded in all of its length by a rather double series of black points. The fins lack spots. The dorsal and the caudal fins are yellowish or grayish, while the pectoral ventral and the anal ones are orange at their base and yellowish in the remaining part. The iris is golden yellow, a little blackish in its upper part. In specimens preserved in alcohol, the back, the sides and the belly almost keep their color, but the orange color of the fins and the yellow of the lateral line disappeared (Stephanidis, 1971). The punctuation of the scales and the peritoneum also remain.

According to data by Tsingenopoulos (1994) and Tsingenopoulos and Karakousis (1996), the species has 2n = 50 chromosomes. Its karyotype consists of 7 pairs of metacentric, 6 pairs of submetacentric, and 12 pairs of subtelocentric-acrocentric chromosomes.

Distribution and habitat. - ***L. keadicus* is endemic of the small river Evrotas** in Peloponnesus (Fig. 3). The species shows a remarkably large variation in habitat preferences. The absence of any competition with other fish species permits it to exploit every available habitat and source of food. Normally, it presents a rather limnophilic character being better adapted to live mainly in still water. So, it is more frequent in the deeper waters of the river and in the ditches of lowland, preferring places where current is approximately slow. In these places, it searches for food up to the surface of the water. However, it is also frequent in main river bed, even there where the current is fast and the water shallow. In the river Evrotas habitats with stony, gravel and sandy bottoms, rarely muddy, are dominant. The species seems to prefer a rather clean and well-oxygenated water, being sensible in any kind of alterations of its habitat.

DISCUSSION

The species in concern presents quite clearly all the characters of the genus *Leuciscus*, although being far from any other isolated species of restricted distribution in the western Balkan area (see Vukovic and Ivanovic, 1971). Therefore, it can be considered as remnant of an old stock, as it is the case of some endemic *Leuciscus* species in Dalmatia (Vukovic and Ivanovic, 1971, Economidis and Banarescu, 1991). The only closely related species seems to be *Leuciscus souffia*, from which *L. keadicus* differs by the general shape of the body and the head and by several morphometric and meristic characters (Table I). So, *keadicus* has a rather slightly compressed and deeper body than *souffia*, in which body is more round and lower. The profile of the head also differs in both species, being rather acute and narrow in *keadicus* and more rounded and broad in *souffia* (Fig. 1b, d). In addition, the eye is larger in the latter species than in the former (Fig. 1b, d), while lips are thicker in *keadicus* than in *souffia*, especially in the middle (Fig. 1a, c). Pharyngeal teeth are close related between these two species but in *souffia* are quite wide (Fig. 2 a, b). Concerning other features, there are several morphometric characters that differ significantly among these two species. Such characters are: the minimum depth of the body, the length of the caudal peduncle, the depth of the dorsal and the anal fins, the length of pectoral and ventral fins, the distance between ventral and anal fins and the

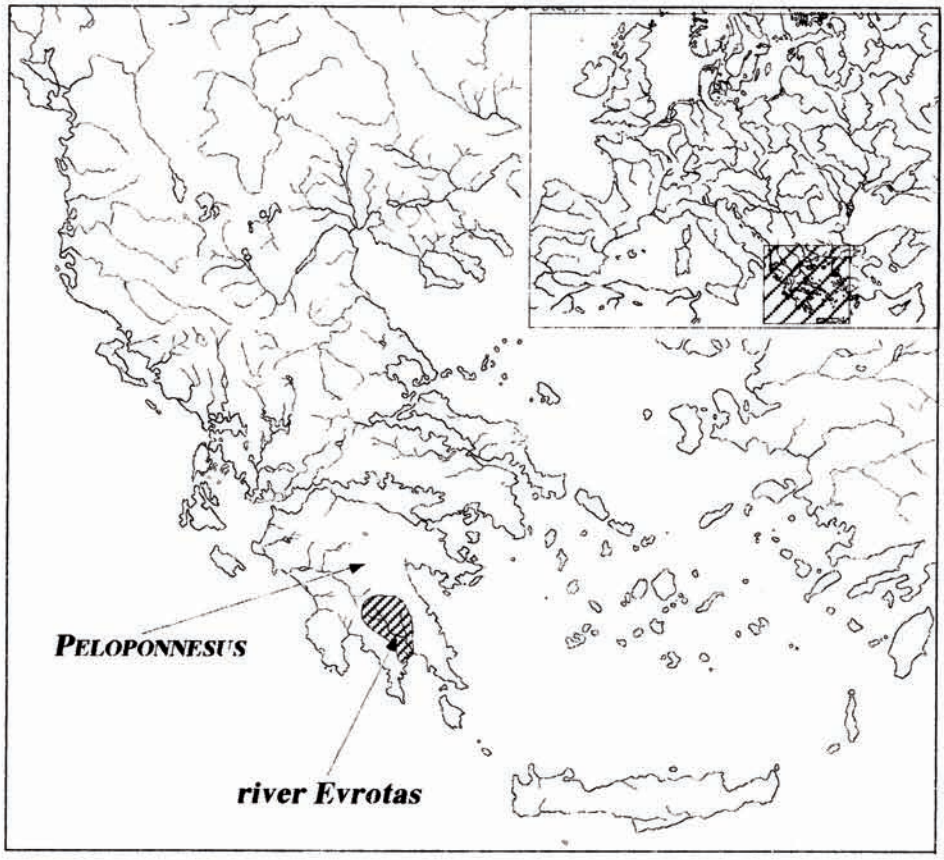

Fig. 3. - Distribution of *Leuciscus keadicus* (original).

preanal distance (Table I). Head proportions are also different, eye diameter, preorbital and interorbital distances being greater in *keadicus*, while postorbital in *souffia*.

Tsingenopoulos and Karakousis (1996) studying the *Leuciscus* species from Greece found that the Nei's genetic distance between *L. keadicus* and *L. cephalus* varies from 0.171 to 0.181 whereas it is 0.251 between *L. keadicus* and *L. borysthenicus*. These results suggest a separation between *L. keadicus* and *L cephalus* for about 3.5 mya (middle Pliocene), and between *L. keadicus* and *L. borysthenicus* for about 5 mya (upper Miocene, Messinian). Hence, given that *L. cephalus* is the only other *Leuciscus* species living in Peloponnese, it can be concluded that isolation of *L. keadicus* is dated at least from 3.5 mya.

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